# SOIL SURVEY OF THE LAKE CHARLES AREA, LOUISIANA.

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## LOCATION AND BOUNDARIES OF THE AREA.

The area surveyed lies in what is known as the "prairie region," in the south-central part of Calcasieu Parish, and comprises a part of Townships 9 and 10 S., lying between Ranges 5 and 10 W.

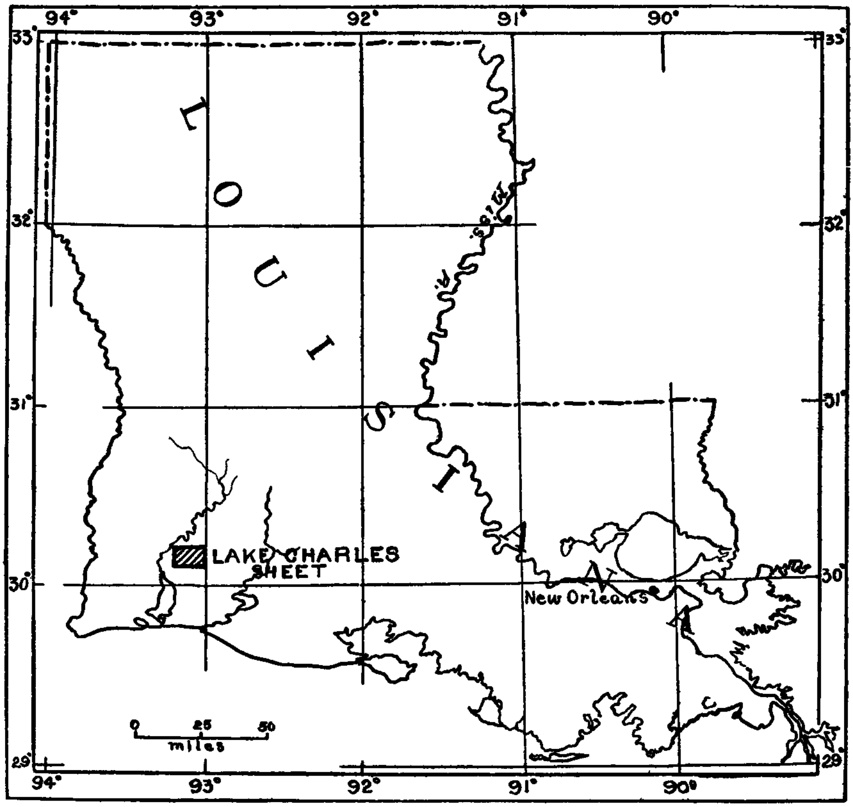


FIG. 25.—Sketch map showing area surveyed in Louisiana.

The area is bordered on the west by the Calcasieu River and on the north by extensive pine forests. The southern and eastern boundaries lie approximately along the south line of Township 10 S. and along Range 5 W. (See fig. 25.)

The city of Lake Charles lies in the extreme western part of the area, and Lacassine, a small railway station on the Southern Pacific Railway, just beyond the extreme eastern part of the area.

## HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The earliest settlements in the region around what is now Calcasieu Parish were made by the French in the seventeenth century, followed during the eighteenth century by some colonization by Spain, when the territory came for a time under the rule of that nation. During the first years of the nineteenth century the territory again reverted to France. The region lying to the east of Calcasieu Parish is known as the Attakapas country, and became the home of the Acadians after their exile from Canada.

As a result of these several earlier attempts at colonization the early population of the new territory was largely French. The descendants of these earlier settlers migrated slowly westward into the surrounding parishes, and so we find that the oldest inhabitants of the area surveyed are the Acadian French. These people invariably made their homes along the wooded streams or near the timbered areas, probably for the reason that the land adjoining such areas had better natural drainage, offered more of the necessities common to early settlement, and lay near to water transportation. These settlements exist at the present time. The people are of agricultural or pastoral habits. They do not have the enterprise of the average American, living more or less in the traditions of the past. Their wants are simple. They farm small areas to supply the common necessities of life, and pasture their cattle upon the surrounding prairies.

In 1803 the United States came into possession of the vast area comprehended in the Louisiana purchase, after which time the history of settlement has been like that of the extreme Southwest generally. It was not until 1884, however, that that impetus to agricultural growth began which has brought the region into prominence in the production of rice. Immediately before this the agriculture of the area was largely restricted to raising range cattle and horses.

The influx of settlers which began in the eighties was composed largely of farmers from the North and the Middle West. The earlier development of the country was slow, though from that time the immigration has continually increased. At the present time many of the enterprises of the locality are being developed by people from more northern States.

The first settlers soon found that rice was a profitable crop for the locality, and their energies were largely turned to its production. In the earlier times, however, only such areas were grown to rice as could be properly watered by small streams and higher lying sloughs, and as such natural facilities were not very common the extension of rice

production was greatly retarded. Farther east, where natural conditions were more favorable, the earlier attempts at rice production were carried on upon a larger scale. The comparatively recent introduction of improved machinery for raising water and the construction of canal systems for its distribution mark the beginning of the rapid extension of rice cultivation in the surveyed area.

## CLIMATE.

The climatic conditions are nearly semitropical, but the high temperature that is found in localities so far south is modified by cool winds from the Gulf of Mexico. The region thus has a rather uniform summer temperature, a moderate winter, and on the whole a very agreeable climate.

The normal monthly and annual temperature and rainfall for the locality, as obtained from records taken by the Weather Bureau station at Lake Charles, are shown in the following table:

*Normal monthly temperature and monthly and annual precipitation.*

| Month. | Temperature. | Precipitation. | Month. | Temperature. | Precipitation. |
|---|---|---|---|---|---|
| | °*F.* | *Inches.* | | °*F.* | *Inches.* |
| January | 51.9 | 6.50 | August | 80.5 | 5.90 |
| February | 54.0 | 4.22 | September | 76.7 | 2.98 |
| March | .......... | 4.34 | October | 68.3 | 2.78 |
| April | 67.8 | 2.35 | November | 58.9 | 5.61 |
| May | 73.7 | 2.40 | December | 53.6 | 3.43 |
| June | 79.0 | 7.39 | Normal annual | .......... | 53.38 |
| July | 80.9 | 5.48 | | | |

The normal mean temperature for spring averages about 70°, with a maximum of 93°. The rainfall for the spring months averages about 14 inches.

The normal mean summer temperature is 80°, with a maximum of 101° and a minimum of 50°. The sunshine record for the summer months is about 50 per cent. The summer rainfall averages 18 inches.

The normal mean temperature for the fall is 68°, with a maximum of 94° and a minimum of 22°. The sunshine for this period averages about 55 per cent. The rainfall averages 10 inches.

The normal mean winter temperature is 52°, with a maximum of 88° and a minimum of 10°. The average sunshine is about 45 per cent. The rainfall for the winter months is 12 inches.

The locality has a slightly higher relative humidity than the rainfall would indicate. This is due to its proximity to the Gulf of Mexico and marsh-land areas.

Ordinary crops are raised without irrigation, though the staple, rice, is always irrigated.

The following table shows dates of last killing frost in spring and first killing frost in autumn for Lake Charles, La.:

*Dates of killing frosts.*

| Year. | Last in spring. | First in fall. | Year. | Last in spring. | First in fall. |
|---|---|---|---|---|---|
| 1894 | Feb. 26 | Dec. 12 | 1898 | Mar. 5 | Dec. 5 |
| 1895 | Feb. 20 | Nov. 27 | 1899 | Mar. 29 | Nov. 4 |
| 1896 | Jan. 26 | Nov. 9 | 1900 | Feb. 19 | Nov. 13 |
| 1897 | Feb. 7 | Dec. 5 | | | |

## PHYSIOGRAPHY.

The physical features of the area are not especially marked. The elevation above sea level along its northern boundary ranges from 18 feet at Lake Charles to 25 feet at Iowa—a station on the Southern Pacific Railway 12 miles east. A slightly higher elevation is found east of Iowa station, where there is a small ridge which forms a watershed between English Bayou on the west and the Lacasine or Indian Bayou on the east.

From these northerly elevations the country slopes gradually southward to sea level. The Gulf of Mexico and its adjoining marshes lie some 25 miles south of the area.

Besides this imperceptible slope southward to the Gulf, there exist also upon the area several small convolutions or ridges having a general northeasterly and southwesterly direction. These ridges serve as small watersheds and determine the general direction of the drainage. An exception to these conditions is noted, however, in the case of English Bayou. This stream has its source in the north central portion of the area, and flows northwesterly into the Calcasieu River.

Lying between the several almost imperceptible watersheds of the area we find generally a disconnected chain of swamp or lowland areas. These swamps were formerly a very much more important physical feature of the land, when they formed overflow channels from more northerly streams that now drain into the Mississippi River. It is likely, also, that later these swamp areas, together with the bayous and lower river channels, were the deeper parts of a broad, salt sea marsh. The deposits of salt-water shells at or near the surface of these old waterways evidence this former condition. Upon the elevation of the land surface the conditions assumed their present appearance. The swamp areas became sealed and practically filled with swamp clays. The line of deepest depressions then became the present channel of the Calcasieu, and the minor overflow channels of the English and Contraband bayous became tributary to the main drainage channel. Farther toward the Gulf the salt marsh still exists, as do the marsh bayous.

The appearance of the area is that of a low, flat, treeless prairie. The low watersheds and swampy depressions give little variation to the general landscape. The better drained portions lying immediately along the streams are wooded. Here and there in the more upland localities on the prairie may be seen an isolated though vigorous young pine, but the greater part of the area is too poorly drained to permit forest growth.

GEOLOGY.

The prairies of southwestern Louisiana are a part of the Coastal Plain that extends from New England southward to the Gulf of Mexico and along the southern border of the United States westward as far as the indenture made by the Gulf.

The outer edge of this plain is topographically young. The Lake Charles area, extending southward to within a few miles of the Gulf marsh, belongs, therefore to the zone which has but recently been raised above the tides.

The upper geological strata of the area belong to the Port Hudson group of the Columbian Quaternary. The Columbian formation overlies the Lafayette. From the upper members of this formation are derived the surface loams of the area in discussion, and the group of clays immediately underlying the loams are deposits of the Port Hudson. The basal Columbia deposits are recognized as the gravels lying immediately over the Lafayette.

The Port Hudson clays were derived from local erosion along streams and from the glacial debris brought down from the north. These clays were deposited as a submarine terrace at the mouths of the channels which transported them.

Through investigations and borings made over the area under discussion, the writer is inclined to believe that immediately over the Port Hudson clays there exists a layer of material other than the brown loams mentioned by Clendenin in his report on the geology of southwestern Louisiana. Indications point toward the deposit of a narrow stratum of red sands and clays[a] at a depth of from 6 to 20 feet below the surface. It is into this stratum that many of the surface wells are sunk.

Immediately below this deposit of red material shallow deposits of marine shells are generally found. Whether or not at the close of the Port Hudson deposition there was a brief period when the sediments of the Red River played a part in the upbuilding of the old Port Hudson terrace, or whether that stream cut temporary channels to the Gulf through the Port Hudson clays and left its mark so near the surface, it is difficult to determine. Certain it is that the sharp, red sand accompanying and underlying the red clay stratum, as found by

[a]Mentioned by Professor Clendenin as having been seen in excavations at Lake Charles.

borings made, does not belong to the finer silts and sands of either the underlying Port Hudson or the overlying clays which to-day form the subsoil of the area.

Overlying the red clays, where encountered, the typical mottled subsoil clays of the area show themselves quite uniformly. The theory advanced by Professor Clendenin is that these sediments were brought to the locality by the Mississippi River. This seems probable, at least in greater part.

These subsoil clays of the area are often highly calcareous. An attempt was made to establish boundaries where such conditions occurred, but this was found impracticable. Indications point toward the bringing in of these silty calcareous clays from the loess districts farther north and east at a time when river debris from other areas was being deposited. The result has been to give these subsoil deposits a more or less variable appearance and texture. Local calcareous deposits occur throughout the entire area. While the general appearance of such calcareous material is more uniformly yellow than the surrounding subsoil clays, the gradation of one into the other is so common that to classify or sort them is impossible.

The special calcareous properties of these clays is shown by the presence of lime concretions or nodules. These nodules vary in size from one-fourth inch to about 4 inches in diameter, the average size being about 1 inch. They are found in every gradation of the subsoil, though the yellower clays contain them most abundantly.

Almost invariably, and in all parts of the subsoil deposit of the area, iron concretions have been found. These concretions are evidently due to the precipitation of iron from the ground water in swamp areas that are poorly drained.

The immediate surface soil of the Lake Charles area appears as a shallow veneering of fine sands, fine sandy loams, loams, and clay loams, upon a substratum of clay. This surface soil owes its origin in greater part, doubtless, to present surface weathering and to local erosion of the underlying clays. The conditions are augmented somewhat by present or very recent overflow depositions in local areas.

Erosion has, however, not gone on to any great extent. As mentioned under physiography, evidences exist of old water courses which have later become swamp bayous and which were finally sealed by the inflow which left the subsoil clays. The Calcasieu River probably occupies one of these old channels, and it is likely the English and Contraband bayous are also remnants of previously eroded drainage channels that have not been entirely filled.

The different soil boundaries of the area owe their position almost entirely to local depressions, to the indifferent weathering brought about largely by heavy rainfall upon a flat, poorly-drained surface, and to the presence of sand mounds or hummocks.

Much has been previously written regarding the sand mounds that have given the prairie region of southwestern Louisiana and eastern Texas the name of "pimpled prairies." These mounds exist more or less numerously over the entire Lake Charles area, and generally upon the more elevated parts of the area they are found at average distances of from 2 to 15 rods apart. In such localities they have an average height of perhaps 2 feet, and a diameter of from 16 to 50 feet. Everywhere the mounds appear as little domes or regular-shaped hummocks.

Occasionally in lowland areas of large dimensions, where the slope is especially gradual, or on flat or broad reclaimed swamp or marsh land very few or even no mounds will show, or if any exist they will appear small and abortive. These lowland areas are heavy soil areas grading from loam to clay loam. It does not follow, however, that all loam areas mapped are devoid of mounds. Most of the loam areas contain them quite plentifully.

Again, in certain swamp areas these mounds are more numerous and of larger dimensions than in any other part of the area. Such swamp areas are generally long and narrow, and the hummocks appear in rows or with a certain amount of regularity, parallel to the swamp edges. Should such swamp areas abruptly broaden, a perfect jumble of these mounds occurs, and the regularity of position is lost, though there is no apparent change in the size of the mounds. The mounds in such localities are from 4 to 7 feet high, with a base diameter of from 30 to 60 feet, and the soil in such areas is quite sandy and has been mapped either as a fine sandy loam or fine sand.

These mounds occur also on the sand areas of the map. On such areas they are generally smaller, more irregular in shape, and flatter, averaging from 18 inches to 2 feet in height and from 16 to 50 feet in diameter. In the timbered sand area large trees (generally pine) group themselves upon the mounds.

Except in the narrow swamp areas no marked regularity in the position of the sand mounds exists. It is true that in all localities where such special features exist the mind is apt to work out special lines of symmetry from a heterogeneous basis, and such has probably been often done regarding these hummocks. Other phases of these mounds exist here and there. One notices occasionally flat, round bases of sand on the prairie or in the field, oftener on uncultivated prairie. These bases have no elevation over the surrounding soil. Their diameter is that of a typical mound. They present a sand surface which generally breaks into the underlying clay at normal depth below the surface. The surrounding soil may be a loam, yet this flat sand surface maintains its position and constitution and may be traced to all its dimensions by the eye, because of the scant vegetation upon it.

In a few instances upon burnt prairie land these flat sand patches run into each other to form a network of blotches, or sand venation. The connecting sand streaks average about 4 feet in width and the

small inclosures of heavy soil show diameters of perhaps from 4 to 10 feet. This phase is very seldom seen.

Cross sections found in the sand mounds in canal and road cuts disclose some variation, but nothing marked. Occasionally in such sections it will be seen that the underlying clay rises somewhat toward the surface under the mound. Other cases disclose no break or irregularity in the surface of the clay, but the mound appears to rest entirely and without any connection upon the surface of the ground.

A large number of borings were made into these sand mounds and many excavations were also examined. The soil composing these mounds is generally a fine sand. Occasionally, and then only in areas of the heavier soils, an admixture of a very little loam is found, though never enough to give the soil a typical sandy loam character. An average section through a mound will show it to contain sand within 10 inches of the surrounding soil surface. Below this top sand will appear a fine silty sand rather yellowish in color and often carrying iron nodules. Under the silty layer the subsoil clay stratum appears. This subsoil clay is at first somewhat sandy and brittle, but grades at a slightly greater depth into the typical clays of the area. Often, as elsewhere, these clays contain lime concretions. In none of the borings or sections were any traces found of the sand pedestal upon which the mounds have traditionally been supposed to rest.

The soil immediately beneath the hummocks is somewhat sandier than the soil in the same level in surrounding positions, which fact is quite natural. It is true, too, that the soil below the hummocks is perhaps not as compact as the surrounding soils, yet this condition might be accounted for by the protection given it by the overlying dome.

In certain cultivated and uncultivated prairie areas there exists about the base of these hummocks a crown or circle showing salts. These crowns average generally about 3 feet in width, and are specially noticeable because of lack of vegetation upon them. In a few instances, where these sandy hummocks have been leveled in order to use the material for road construction or in leveling a cultivated field, the flattened sandy surfaces thus left have become entirely covered with salt crust. In swamp areas used for cattle ranges slight depressions will often be noticed about the bases of the hummocks. These depressions have been made by the trampling of cattle attracted to such spots by the salt.

All hummocks do not present an "alkali crown," the phenomenon appearing most common in cultivated fields. This is, perhaps, due to the fact that these sand hummocks serve as points for excessive evaporation for the surrounding flooded rice land. The physical phenomenon wherein the salt or alkali seeks the higher margins due to capillarity, as so often seen in the alkali areas in the West, augments the development of these "crowns."

It is difficult to explain the origin of these sand mounds. That they have influenced the soils of the area is everywhere evident. That they are products of some natural phase of geological development seems also probable. That the material in them was originally laid under water or in marshes is intimated by the presence of iron concretions and the lower silt or quicksand stratum which is often present. That the underlying materials are identical with the subsoils of the area is also quite regularly shown.

A theory has been advanced that ascribes the origin of the sand mounds to the escape of gases. It is difficult, however, to adopt such a theory upon the basis of gas forced from the probable petroleum area of the locality, found several hundred feet below, while if such gas originated in shallower depths it is highly probable that the same condition would appear in many more and over wider coastal areas. It is also probable that had such gases emanated with force enough to produce mounds, the residue would have been composed of fine silts and mud rather than sand.

The origin of the mounds may more likely be ascribed to erosion upon a previously laid sand terrace. We find in the geological history of all the coastal area that certain periods developed numerous sand strata. Examples of this are seen in the sand strata overlying the sulphur beds near Sulphur, La., and also in the artesian-well and the salt-well areas of Louisiana. Should the development of the terrace in this locality have closed with a sand stratum, it is probable that the mounds are the last remnants of such a terrace. Indications are that such is the case. Perhaps the strongest evidence of this is to be found in the large sand areas of the locality platted and in the existence of embryo mounds upon such areas.

As we approach the Gulf coast, and in areas of depression in the underlying clays, we find these sand remnants or mounds larger and more numerous. This we would expect, since the depth of the deposit would have been deepest nearest the Gulf and in local depressions previously eroded by streams.

The peculiar regularity of distribution and shape maintained by the sand mounds seems at first a vital defect in the theory that their origin lies in erosion of a sand terrace. When we consider, however, that the topography of the area establishes but an indifferent drainage, the even distribution of the sand remnants becomes a normal feature. The domelike shape and circular base presented by the mounds is accounted for by the occurrence of the lower silt stratum found in the mounds.[a]

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[a] See Le Conte's description of prairie mounds of eastern Oregon. (Proc. Calif. Acad. Sci., vol. 5, p. 219.)

The following mechanical analysis of the soil from a typical mound shows the general character of the material:

*Mechanical analysis of soil from a sand mound.*

| No. | Locality. | Description. | Organic matter and combined water. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6413 | 14–40 sec. 35, T. 9, R. 7. | Sand from hummock. | 3.08 | 0.54 | 0.56 | 0.22 | 7.56 | 31.98 | 48.96 | 6.72 |
| ANALYSIS OF SAND OCCURRING IN RED CLAY STRATUM FOUND BELOW SUBSOIL CLAYS OF THE AREA. | | | | | | | | | | |
| 6412 | 1–40 sec. 34, T. 10, R. 6. | Sand, 14 to 15 feet.. | 1.08 | ...... | ...... | Tr. | 34.46 | 53.56 | 4.24 | 5.12 |

The lime nodules found in various parts of the area have likely developed from the calcareous clays, often carrying shells. These nodules are found at depths below the surface varying from a few inches to about 5 feet, and often are formed of a nucleus of clay material surrounded by a hardened limestone shell. The nodules are more or less rough of surface and irregular in shape.

These concretions are not distributed with any regularity, but are found more abundantly in the more yellow clays. The close proximity of the mottled to the yellow clays carrying lime concretions, and the abrupt and unexplainable changes from mottled to yellow clay, have given rise to the conjecture that the nodules are in some way responsible for the yellow color.

## SOILS.

The virgin soils of the area are everywhere covered with prairie and swamp grasses. The more upland sandy localities have also a scattered growth of pine.

Owing to the heavy rainfall and the poor natural drainage of the area, the condition of the soils is often at first antagonistic to agriculture, and their fertility is often not shown until some time after cultivation and aeration.

The classification of the soils, as shown upon the soil map, is based upon their texture in the field. The types platted represent intricacies not commonly met with in other than glacial areas. The influences of the ever-present sand mounds and of the low ridge and swale formations have resulted in a heterogeneous mixture and a corresponding difficulty of separation of the types, which generally grade gradually into one another.

The mechanical analyses of the soils of the area show an invariably high silt content. In the field these conditions are materially masked by the flocculating tendencies of the soil particles, and hence their true condition is not disclosed. In the laboratory the processes employed succeed in completely separating the soil particles and classifying them.

The soils of the area have been classified into six types. In one or two cases modifications of a type have not been indicated upon the map, but have been discussed as phases under the type name.

The types are as follows:

*Areas of different soils.*

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent. |
|---|---|---|---|---|---|
| Lake Charles fine sandy loam | 53,300 | 41.2 | Calcasieu fine sandy loam | 5,500 | 4.3 |
| Calcasieu loam | 51,280 | 39.6 | Lacasine clay loam | 3,470 | 2.7 |
| Calcasieu fine sand | 13,970 | 10.8 | Lake Charles loam | 1,770 | 1.4 |

### LAKE CHARLES FINE SANDY LOAM.

The Lake Charles fine sandy loam occurs on the upland prairie regions of the area and forms the main soil of the low divides that extend between slough areas. The surface of this type is characterized by the presence of the sand hummocks, which have played an important part in its formation.

The typical soil is a fine sandy loam, grading from a dark-brown, or black to gray or ash color, and having a depth of from 8 to 20 inches, with an average depth of about 14 inches. Beneath this to a depth of 10 inches lies a loam which grades first into a clay loam and finally into a mottled clay. The soil and the several subsoil strata all contain silt, which is most plentiful in the clay loam and clay. The subsoil also often contains both iron and lime concretions. These do not occur at the same depths, however, the iron concretions generally occurring at greater depth.

The soil owes its texture to its upland position and to the presence of the sand mounds. Local erosion has carried from the type some of the finer loam it once contained, and has mixed with it the sand from the hummocks. The texture varies according to location, being somewhat more sandy near the crests of the ridges and merging gradually into loam near the areas of depression. The variations in texture, however, are not wide. The range in color is due largely to the state of cultivation. The virgin prairie soils are usually of the darker color, while where the soil has been cultivated for some time it assumes the lighter ashy hue. The change is caused both by the loss of organic matter and the admixture of less weathered parts of the subsoil with the top soil.

The crops grown on the soils of this area are not varied, rice being the staple. Under favorable conditions this type of soil may yield 10

sacks[a] of rice per acre, but owing primarily to drought the average yield for the season of 1901 would perhaps be nearer 7 than 10 sacks. Owing to the position of the Lake Charles fine sandy loam in the uplands, it is sometimes difficult to adequately flood it.

Small patches of corn are grown on this soil, though with the methods of cultivation employed the yield is uniformly low.

Sugar cane does well if properly cultivated, the yield being satisfactory and the sugar content high. However, in the area surveyed there were no large fields planted to this crop, it being grown only in patches ranging from one-fifth of an acre to 2 acres, and then solely for the manufacture of molasses for home consumption.

The crops to which this soil is adapted are such as do well upon light soils. It is doubtless well adapted to truck, to some kinds of fruits, and to cereals which do not require an excess of moisture. At present it is practically limited to rice. The Lake Charles fine sandy loam is fertile for a soil of its texture, though in rice growing it is found to be profitable to apply about 60 pounds per acre of a fertilizer consisting of bone phosphate and potash.

The Lake Charles fine sandy loam, in comparison with other soils of the area, is moderately well drained. With a somewhat deeper cultivation than is practiced, and with thorough drainage, the soil should yield adequate returns. Under such conditions alfalfa, some of the clovers, the southern cowpea, millet, or Egyptian corn might be grown.

The texture of soil and subsoil of the Lake Charles fine sandy loam is shown in the following table:

*Mechanical analyses of Lake Charles fine sandy loam.*

| No. | Locality. | Description. | Organic matter and combined water. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6410 | 4-40, sec. 28, T. 10 S., R. 7 W. | Fine sandy loam, 0 to 13 inches. | 2.50 | 0.66 | 0.36 | 0.20 | 6.42 | 33.36 | 50.40 | 6.02 |
| 6406 | 4-40, sec. 8, T. 10 S., R. 8 W. | Fine sandy loam, 0 to 14 inches. | 2.00 | 2.40 | .40 | .18 | 3.66 | 21.60 | 61.02 | 8.40 |
| 6403 | 15-40, sec. 22, T. 10 S., R. 9 W. | Fine sandy loam, 0 to 8 inches. | 2.58 | .40 | .86 | .26 | 4.24 | 30.16 | 48.50 | 12.82 |
| 6407 | Subsoil of 6406.... | Heavy loam, 14 to 36 inches. | 3.62 | .14 | .80 | 1.28 | 5.28 | 15.08 | 51.98 | 20.92 |
| 6404 | Subsoil of 6403.... | Loam, 8 to 36 inches. | 2.18 | .72 | .72 | .30 | 4.18 | 31.16 | 43.02 | 17.64 |
| 6405 | Subsoil of 6404.... | Clay loam, 36 to 72 inches. | 3.10 | ...... | .08 | .08 | 2.36 | 20.36 | 40.10 | 34.02 |

[a] A sack of rice weighs from 140 to 200 pounds, the average being about 172 pounds.

### CALCASIEU LOAM.

The Calcasieu loam is found mostly in poorly drained areas of depressions. The formation of the surface soil of this type has been due largely to the drifting in of the finer loam from higher adjacent areas. The effect of this has been to bring in upon the subsoil clays a covering of loam of variable depths. The soil has also been produced, especially in the northern parts of the area, by the weathering of underlying clays and clay loams. The sand hummocks are more scattered in the Calcasieu loam areas than in other soils, and in a few areas are almost entirely absent.

The Calcasieu loam appears in two phases. In the typical prairie districts we find it as a dark loam, grading to brownish-gray or gray, mixed with fine sand and silt, while in the northern and northeastern parts of the area, the type is of a brown color and owes its loamy properties more to the underlying clay.

This soil varies in depth from 6 to 16 inches, with an average depth of about 10 inches. It grades into a clay loam, varying in thickness from a few inches to about 1 foot, below which lie the mottled clays distributed so generally over the area. The materials of which this soil is made up are in a more or less undecomposed condition. In the subsoil are found many iron and lime concretions.

The following mechanical analyses of this type and its subsoil show their texture:

*Mechanical analyses of Calcasieu loam.*

| No. | Locality. | Description. | Soluble salts, as determined in mechanical analysis. | Organic matter and combined water. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6374 | 1-40, sec. 1, T. 11 S., R. 9 W. | Loam, 0 to 12 inches. | 0.04 | 3.10 | 0.30 | 0.20 | 0.14 | 3.86 | 20.50 | 62.52 | 9.20 |
| 6370 | 4-40, sec. 27, T. 10 S., R. 7 W. | Loam, dark phase, 0 to 12 inches. | .02 | 2.82 | .44 | .46 | .34 | 4.08 | 19.06 | 60.46 | 12.28 |
| 6372 | 16-40, sec. 12, T. 10 S., R. 7 W. | Loam, dark phase, 0 to 10 inches. | .01 | 1.64 | ...... | ...... | ...... | 2.40 | 16.96 | 57.56 | 21.06 |
| 6375 | Subsoil to 6374.... | Clay loam, 12 to 24 inches. | .08 | 2.44 | .70 | .68 | .60 | 2.70 | 24.60 | 52.24 | 15.10 |
| 6376 | Subsoil of 6374.... | Clay, 24 to 60 inches. | .11 | 2.64 | .32 | .40 | .38 | 2.76 | 22.60 | 50.78 | 19.08 |
| 6371 | Subsoil of 6370.... | Clay loam, 12 to 30 inches. | .01 | 2.10 | .38 | .50 | .30 | 4.08 | 15.54 | 56.72 | 19.92 |
| 6373 | Subsoil of 6372.... | Clay loam, 10 to 32 inches. | .01 | 3.64 | ...... | .04 | .08 | 2.74 | 10.24 | 58.86 | 24.52 |

The Calcasieu loam is the typical rice soil of the Lake Charles area, and is admirably adapted for the production of this crop. The loamy nature of the soil permits of easy and early cultivation and brings planting and harvesting more within the control of the grower than where the soil is more clayey, while the underlying stratum of impervious clay prevents loss of water during the period when the fields are kept flooded. The average yield of rice on this soil is somewhat better than on the Lake Charles fine sandy loam, the average being about 12 sacks to the acre. In 1901 the actual yield, as determined from data collected in the field, ranged from 8 to 14 sacks to the acre. The natural drainage of most of this soil is poor, and artificial drainage would greatly benefit it. With proper drainage this land could be used to produce other crops adapted to the heavier soils.

### CALCASIEU FINE SAND.

The Calcasieu fine sand occurs along the Calcasieu River, along the east shore of Lake Charles, and in many detached areas of greater or less extent in the northern and eastern parts of the area. The typical soil, which occupies large areas along the river and lake in the northwest, the highest ridges and divides to the north, and sometimes small areas on the prairies, is a loose, incoherent gray sand, containing some silt. It usually has a depth of about 18 inches, and grades into a loam that in turn passes abruptly into the mottled clay at a depth of 28 inches from the surface.

There are several variations from this type, one of which occurs in a number of irregular detached areas lying in sections 2, 3, 10, 11, 29, and 30 of T. 10 S., R. 6 W. These occupy the centers of sloughs, or are due to large sand mounds. They are covered with swamp grasses and broom sedge and at present have little or no agricultural value, though they were formerly cultivated in rice, it would seem with meager success.

Another phase is the yellow fine sand or fine sandy loam, which occupies a strip about one-half mile wide, extending along the east shore of Lake Charles, the east bank of Calcasieu River south of English Bayou, and along Osier Bayou. This phase passes rather abruptly into the contiguous fine sand areas, losing its loamy characteristics and yellow color. This phase is apparently of alluvial origin, the material having been brought down by the streams and deposited in narrow bands along their courses.

The Calcasieu fine sand, with the exception of the yellow phase just described, has the same origin as the soils already described. The sand areas represent larger remnants of the overlying sand terrace that once covered the entire area; the sand mounds are the lesser remnants. This soil is in a fairly advanced state of decomposition.

The following mechanical analyses show the texture of the soil and subsoil:

*Mechanical analyses of Calcasieu fine sand.*

| No. | Locality. | Description. | Soluble salts, as determined in mechanical analysis. | Organic matter and combined water. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6377 | 16-40, sec. 27, T. 9 S., R. 8 W. | Fine sand, 0 to 20 inches. | 0.02 | 1.94 | 0.46 | 0.50 | 0.28 | 25.22 | 33.78 | 32.02 | 6.06 |
| 6383 | 1-40, sec. 26, T. 9 S., R. 8 W. | Fine sand, 0 to 24 inches. | .01 | 1.64 | ...... | ...... | ...... | 28.90 | 34.32 | 27.90 | 7.22 |
| 6386 | 2-40, sec. 4, T. 10 S., R. 8 W. | Fine sand, 0 to 16 inches. | .01 | 3.10 | ...... | .32 | .12 | 13.54 | 42.02 | 33.04 | 8.14 |
| 6381 | 5-40, sec. 5, T. 10 S., R. 8 W. | Fine sandy loam, 0 to 18 inches. | .01 | 2.18 | 1.18 | .90 | .46 | 12.16 | 32.66 | 33.98 | 13.50 |
| 6378 | Subsoil of 6377.... | Clay loam, 20 to 30 inches. | .05 | 3.92 | ...... | .42 | .44 | 14.70 | 25.92 | 38.58 | 18.58 |
| 6384 | Subsoil of 6383.... | Clay loam, 24 to 48 inches. | .01 | 3.08 | ...... | ...... | ...... | 23.40 | 18.68 | 34.50 | 19.62 |
| 6382 | Subsoil of 6381.... | Clay, 18 to 30 inches | .01 | 3.72 | .42 | .26 | .20 | 9.92 | 21.28 | 25.60 | 38.40 |

The Calcasieu fine sand is not extensively cultivated. Some truck is grown upon it, and these crops do exceptionally well. Near the river there are also some small, thrifty orchards, among them an orange orchard, which at the time the survey was made was in a most promising condition. The soil, when cleared, put in condition, and properly cultivated, should yield good returns from trucking and fruit growing. The greater part of the Calcasieu fine sand is now covered with a scattered growth of pine.

### CALCASIEU FINE SANDY LOAM.

The Calcasieu fine sandy loam is the lowland phase of fine sandy loam, occurring in narrow slough areas, and generally surrounding more sandy areas. It is a fine sandy loam in texture, containing a relatively high percentage of silt, grading from a light ashy color to a lighter gray, and when dry having a chalky color and texture. It owes its origin largely to wash from the surrounding soils. The slough areas where this soil occurs have a rather abrupt lateral dip and a slight fall. During the rainy season the current is sufficient to carry the loams farther down the drainage trough, but not swift enough to transport the coarsest sands, silts, and a part of the clays. As a result, the more narrow slough areas are clogged with this soil. The type occurs, however, only in small areas, and were it not for its lighter

character and its lack of organic matter and cohesive properties, it would correlate nicely with the Lake Charles fine sandy loam. Its position is, however, just the opposite of that type.

This soil is not far advanced in decomposition, is not rich in plant food, lacks staying qualities, and is not agriculturally important. The heavier phases of the type, where this soil grades into the loams of the area, are perhaps desirable, though such areas are of limited extent.

The depth of the surface soil for this type ranges from 8 to 20 inches, with an average depth of 14 inches. The type grades to a loam carrying more or less silt, and thence, at about 2 feet, to the typical underlying clays.

This soil, as stated, is situated in the trough of the drainage channels. Where such channels have adequate outlet it is well drained, but where they are impeded the type is often covered with water.

The following mechanical analyses show the general texture of the type:

*Mechanical analyses of Calcasieu fine sandy loam.*

| No. | Locality. | Description. | Soluble salts, as determined in mechanical analysis. | Organic matter and combined water. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6391 | 14-40, sec. 36, T. 9 S., R 6 W. | Fine sandy loam, 0 to 12 inches. | 0.01 | 1.64 | ...... | ...... | 0.06 | 14.60 | 32.96 | 40.26 | 10.52 |
| 6387 | 16-40, sec. 23, T. 9 S., R. 6 W. | Fine sandy loam, 0 to 18 inches. | .01 | 1.58 | ...... | 0.18 | .16 | 6.96 | 27.68 | 51.30 | 11.66 |
| 6389 | 5-40, sec. 14, T. 9. S., R. 6 W. | Fine sandy loam, 0 to 12 inches. | .01 | 1.78 | ...... | .24 | .20 | 8.26 | 22.90 | 53.72 | 12.76 |
| 6392 | Subsoil of 6391.... | Clay loam, 12 to 20 inches. | .01 | 1.94 | ...... | .58 | .16 | 17.66 | 20.56 | 44.84 | 14.00 |
| 6388 | Subsoil of 6387.... | Loam, 18 to 36 inches. | .02 | 3.22 | ...... | .46 | .80 | 11.12 | 21.52 | 45.74 | 17.50 |
| 6390 | Subsoil of 6389.... | Loam, 12 to 18 inches. | .01 | 1.40 | ...... | .24 | .26 | 8.44 | 21.34 | 57.74 | 10.70 |

## LACASINE CLAY LOAM.

The Lacasine clay loam occurs in large areas in the southeastern part of the area and in narrow and unimportant strips along the banks of streams, lakes, and bayous. The larger areas of this soil are found in the lower, flat, swamp areas, which are practically free from sand mounds. The soil is much heavier than the soils where the sand mounds occur and merges into the heavier clays a short distance below the surface. It is doubtless derived from the weathering of the subsoil material.

The Lacasine loam is a heavy, dark-brown or black clay loam, ranging in depth from 10 to 24 inches, with an average depth of 20 inches. The soil passes directly into a clay subsoil that is usually mottled blue and yellow, with the blue color predominating. Lime nodules occur throughout the subsoil, though not so plentifully as under some of the other soils, and the iron concretions so commonly met with throughout the area occur here also.

The areas occurring in narrow strips along the water courses vary slightly from the typical soil. They have been derived through the removal of the top soil by erosion and the consequent outcropping and weathering of the underlying clays. This phase is a clay loam having a depth of about 20 inches. From 20 to 48 inches the underlying material is a yellow clay containing lime nodules; thence to 6 feet below the surface the subsoil merges into the more mottled clay which is underlain by successive thin strata of red clay, sand, and shell beds.

In its natural state the Lacasine clay loam is apparently a heavy, compact clay. It is generally poorly drained and difficult to till, and only after cultivation, exposure, and weathering does it become in good condition. When this has occurred the soil is excellent for the growing of rice, and an average yield of 13 sacks per acre has been produced, with exceptional yields (on ground particularly well aerated and disintegrated) much larger. Owing to its very heavy character, however, cultivation is more difficult than upon some other rice soils of the area.

Mechanical analyses of typical samples of the soil and subsoil of this type are given in the table below:

*Mechanical analyses of Lacasine clay loam.*

| No. | Locality. | Description. | Soluble salts, as determined in mechanical analysis. | Organic matter and combined water. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6397 | 4-40, sec. 26, T. 10 S., R. 7 W. | Clay loam, 0 to 4 inches. | 0.01 | 3.24 | ...... | 1.36 | 2.72 | 11.60 | 19.36 | 44.60 | 17.62 |
| 6395 | 15-40, sec. 22, T. 10 S., R. 6 W. | Clay loam, 0 to 22 inches. | .02 | 3.72 | ...... | .36 | .26 | 6.04 | 11.24 | 60.32 | 17.84 |
| 6393 | 8-40, sec. 25, T. 9 S., R. 8 W. | Clay loam, 0 to 12 inches. | .06 | 3.56 | ...... | .30 | .20 | 3.20 | 19.40 | 55.20 | 18.26 |
| 6398 | Subsoil of 6397.... | Clay, 4 to 36 inches. | .01 | 3.70 | ...... | Tr. | .20 | 3.52 | 10.34 | 51.80 | 30.42 |
| 6396 | Subsoil of 6395.... | Clay loam, 22 to 36 inches. | .01 | 3.06 | Tr. | .30 | .10 | 4.24 | 13.38 | 59.82 | 18.88 |
| 6394 | Subsoil of 6393.... | Clay loam, 12 to 36 inches. | .06 | 2.76 | ...... | .18 | .14 | 2.28 | 14.72 | 56.08 | 23.96 |

## LAKE CHARLES LOAM.

The Lake Charles loam occurs only in a few scattering areas, usually lying in lowlands or swamps, where the conditions are such as to permit the finer loams from the surrounding areas to drift in. The soil is a black or bluish-black fine loam, containing much organic matter and having a depth of about 14 inches. It is quite heavy in texture, and in a more advanced state of decomposition than the other soils of the area. The surface soil merges into clay loam at a depth of about 14 inches, and is underlain below 2 feet by clay.

The soil though difficult to till, is nevertheless quite fertile and produces an average yield of about 12 sacks of rice per acre.

The texture of the soil and subsoil of the Lake Charles loam is shown in the subjoined table:

*Mechanical analyses of Lake Charles loam.*

| No. | Locality. | Description. | Organic matter and combined water. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6401 | 16-40, sec. 8, T. 10 S., R. 7 W. | Loam, 0 to 12 inches. | 4.04 | 0.10 | 0.48 | 0.18 | 6.24 | 17.12 | 60.88 | 11.22 |
| 6399 | 14-40, sec. 5, T. 9 S., R. 7 W. | Loam, 0 to 20 inches. | 4.94 | ...... | .44 | .66 | 6.64 | 11.10 | 41.42 | 35.10 |
| 6402 | Subsoil of 6401.... | Clay loam, 12 to 24 inches. | 2.62 | 1.26 | 1.00 | .48 | 6.12 | 18.12 | 56.22 | 14.56 |
| 6400 | Subsoil of 6399.... | Clay loam, 20 to 36 inches. | 3.14 | ...... | .18 | .20 | 7.08 | 18.66 | 37.12 | 34.10 |

## SPECIAL SOIL PROBLEMS.

Quite a little interest is being shown among the planters in the question of fertilizers and their application in rice culture.

Unfortunately, at this time it is impossible to get data enough upon the subject to rationally discuss it. The industry is new to the area, the oldest fields being but a few years old. As yet it is not known what the best methods are for cultivating some of these soils. Some of them have hardly, as yet, been worked long enough to prove their value. The question of proper drainage is also important and should be considered.

The Acadian settler has for the past twenty or thirty years fertilized the small plats of ground upon which he has grown his patch of corn or cane, yet if his present methods of cultivation are the same as

twenty years ago, the fact that he must fertilize in order to produce growth of any kind is not strange.

Regardless, however, of the question of fertility of the rice soils, many progressive farmers are using fertilizers and are satisfied that the practice is profitable.

In the Lake Charles area the fertilizer generally applied to rice soils is an acid bone phosphate containing about 4 per cent of potash. This is drilled in with the seed, from 40 to 70 pounds being applied per acre. Rice is sown on dry ground and permitted to grow about six weeks before being flooded. The fertilizer thus acts as it would with any dry-farmed crop for that period. How much is lost to the crop by the flooding is a matter upon which there is no authoritative information. The crop is kept flooded until a few weeks before harvesting.

It is probable that the fertilizer exerts its greatest influence on the crop during the first few weeks of its growth. Whatever soluble fertilizer remains at the time of first flooding doubtless goes into solution in the flood water and fails to further influence the crop. The substitution of a slow-acting fertilizer in part for that now in common use might aid the crop during its entire period of growth, though no experiments have been tried to demonstrate the value of such a practice.

In the milling of rice the by-product of rice hulls, or the outer coating of the rice, is thrown out and burned. Where the milling industry is large it would seem that some other disposition should be made of this product.

Perhaps no phase of the rice industry in the vicinity of Lake Charles is of more importance, or will be of more importance in the very near future, than that of drainage. The natural drainage is poor. All parts of the area are underlain by an impervious clay subsoil, and while this is a very valuable feature in the cultivation of rice, and contributes as much to the profitable production of this crop as any other single item, aside from that its presence is not so desirable.

The effect of the underlying clays is to prevent the downward percolation of ground water, and almost all the water used to flood the rice fields must therefore either run off over the surface or slowly seep through the surface soils into the sluggish drainage channels. The effect of this is to waterlog the surface soils for a greater part of the year. Such a condition is not conducive to soil disintegration or to the production of plant food in the soil. Prolonged airing, and sunshine, and other natural agencies are of the highest importance in cultivation, and it follows that without proper surface drainage these conditions can not ensue.

Without proper drainage of the rice fields good roads are impossible. The practice of opening the dikes and turning the water in

any and all directions, which now obtains, damages the roads and menaces the rights of other planters and the health of the community.

A system of drainage in the rice belt is as important as is a system of irrigation, and it is a more complex problem than the latter. Some system whereby the flood water from the rice fields could be rapidly and entirely removed after it had served its purpose should be found. A system of open ditches, dug deep enough to meet the requirements of all lands of the area traversed, would serve.

## METHODS OF CULTIVATION AND IRRIGATION.

The first methods employed in growing rice in this section depended upon the supply of water furnished by rainfall, and only such lands as could be flooded by gravity were cultivated. The fields were, therefore, lowland or flat areas, which were diked at certain intervals to control the depth of water that was later to be brought to them. Above these areas reservoirs were sometimes constructed to collect drainage waters. The management of the crop was otherwise much like that employed upon the areas now under the irrigation canals. Intervals of dry years came on, however, during which the water supply was insufficient, and the industry declined. At the present time evidences of this earlier method of rice farming are often seen on the prairies of the area. The method, because of its dependence upon natural agencies for a supply of water, and in contrast to the late and improved methods employed for obtaining water, has been called "Providence rice farming." The method is yet practiced by Acadians in a few isolated and small tracts in the Lake Charles area.

Under the present method of cultivation the rice fields are plowed, generally in the spring, after which they are disked and harrowed and made ready for sowing. The seed is sown with drills such as are ordinarily used in sowing other cereals. In fact, the general methods employed are much like those used for wheat.

Rice is sown during the months of March, April, May, and as late as early June. On large areas a succession of sowings is made, so that the crop will not all mature at the same time, as rice should not be allowed to stand long after ripening.

Most planters depend upon the moisture present in the soil at the time of sowing to germinate the crop. The crop is allowed to grow until several inches high, when it is flooded, and the supply of water maintained until the crop is nearly ripe. With the first signs of maturity the water is drained from the field and the grain is harvested as soon as the soil has become dry enough to go over it with horses and machinery. The aim is to have the field in this condition at the full ripening of the grain.

The machinery used in harvesting rice is the same as that used in the grain fields farther north, with additional special appliances to pre-

vent sinking into the wet soil. The rice is shocked or stacked, after which it is thrashed with an ordinary steam-power separator. A rice field in harvest time has much the appearance of a wheat field.

The rice grain is covered with an outer coat or husk within which is the rice seed proper. After thrashing, this "rough rice" is milled by processes which separate the husks, take off the outer seed coating or bran, and polish the kernel. During the milling process some of the rice is broken. This broken rice, which is considered of less value, is screened from the first quality, and is used for food or sold to brewers.

The yield of rough rice is generally reported in sacks. The average weight of a sack is 172 pounds, and the weight ranges from 140 to 200 pounds.

The other crops cultivated upon the area amount to little. Small patches of corn, cane, sweet potatoes, and garden truck are grown. No advance, such as has recently taken place in rice production, has been made in the production of these crops. With greater demand certain of the lighter soils of the area should be quite valuable for trucking and fruit growing.

The growth of the rice industry in this section of the South has been made possible largely through the introduction of a system of irrigation using steam-power pumps.

The greater part of the water for irrigation is obtained from the streams or the bayous tributary to the Calcasieu River, although some part is drawn from deep wells. The bayous are short, deep, and of intermittent flow, and receive their water not so much from the drainage of the surrounding country as from the river. None of the irrigation plants take water directly from the Calcasieu River. The water is of very good quality and the supply adequate.

Most of the water for irrigation is taken from the Serpent, English, and Contraband bayous. Since these streams are somewhat lower than the surrounding country, and since it has been found impracticable and expensive to bring water by gravity from the Upper Calcasieu River, the method of lifting water from the streams by machinery has been resorted to.

Large canals are constructed on the surface of the ground by the building of levees several feet high. These levees are higher in areas of depression and are so constructed that an average water level is maintained within the canal between the point of intake and some point farther back in the district to be irrigated. The length of these first levels varies from less than a mile to 3 or 4 miles, depending on the slope of the land. The water is carried through the first section of canal until the elevation of the land makes relifting necessary. At these relifts the water is raised from the first section of the canal into another section. In this manner the water taken from the bayou is carried to the higher levels by a series of canals and relifts. The

water in the canal sections is given a fall of about 2 inches per mile, but the velocity of the current established at the relifts is largely depended upon to give flow to the water.

These canals follow the slight ridges where possible, and laterals are thrown out at intervals to widen the areas irrigated.

The system of flooding the fields is known as the check system. Lands of the same level are surrounded by low levees and the depth of water maintained within them. These checks vary in size, ranging from a part of an acre on uneven areas to fields of many acres in the more level areas.

The fields are not generally leveled down or cleared of the sand mounds, though if this were done it would no doubt prove profitable.

The oldest canal in the area is that of the Contraband Bayou Company, which was constructed in 1898. The water for that canal is lifted 14 feet from Contraband Bayou by means of an 18-inch centrifugal pump. The water is carried back in a main canal 80 feet wide, about 1½ miles from the intake, where a relift, also supplied with an 18-inch centrifugal pump, is constructed. At this relift the water is raised 6 feet and emptied into a canal, from which the water is distributed for irrigation. The length of this canal is 5 miles, and its laterals measure as much more.

The next canal to be constructed was Nason and Frazer's, which was built in 1899. This canal takes water from English Bayou, using an 18-inch centrifugal pump, and carries it back to a relift about 2 miles distant.

In this system the water is raised 17 feet at the intake and 5 feet at the relift. This canal has a width of 60 feet and an irrigating capacity of about 2,000 acres. During 1901 about 1,200 acres were actually irrigated.

The next canal, constructed in 1899 and first used in 1900, is that under the control of the North American Land and Timber Company. This is the largest canal in the area. Its length, with present extensions, is 22 miles, not including a number of miles of laterals. The main canal has a width of 100 feet and carries water at an average depth of 36 inches.

The water is taken from English Bayou, the lift being 16 feet. The first relift is about 1½ miles from the intake. The lift here is about 7 feet. The water is further raised by other relifts along the route of the canal. The capacity of the pump at the initial intake is 45,000 gallons per minute.

The canal of the Paola Company was completed in 1900. It takes its water from Serpent Bayou. The length of main in this canal is 8 miles, with 11 miles of laterals. The main canal for 6 miles has a width of 150 feet, after which it maintains a width of 80 feet. It carries water at an average depth of 39 inches.

The water is lifted at the intake a distance of 21½ feet, and at the first relift 6 feet. The plant at the bayou is equipped with three 18-inch centrifugal pumps. The capacity of this canal is at present sufficient to irrigate about 6,000 acres. During 1901, 2,500 acres of rice were grown under it.

The Indian Bayou Company's canal takes its water from the Lacasine Bayou. The supply of water is adequate and the quality good.

The Indian Bayou canal was completed in 1901. It consists of two portions, a dredged portion and main canal. The dredged portion is 2 miles long, having an average width of 24 feet and depth of 6.5 feet. The dredged part carries water by gravity from the Lacasine Bayou to the pump. The capacity of the intake is 18,000 gallons per minute. The lift is 15 feet.

The width of the main canal is 120 feet for 2 miles, and for 1¼ miles 100 feet. The average depth of water in the main canal is 24 inches and the fall of the canal 1 foot per mile.

There are two relifts. The first raises the water 7 feet, and the pump at this junction has a capacity of 2,000 gallons per minute; the second raises the water 4 feet and has a capacity of 5,000 gallons per minute.

The irrigable area under the canal is 25,000 acres; this year 4,000 acres were irrigated.

Chemical analyses of the waters of English and Indian bayous were made in the laboratories of the Bureau, the results being shown in the following table:

*Chemical analyses of irrigation waters, in parts per 100,000.*

| Ion. | English Bayou, near Nason and Frazer's plant. | Indian Bayou. | Conventional combination. | English Bayou, near Nason and Frazer's plant. | Indian Bayou. |
|---|---|---|---|---|---|
| Calcium (Ca) | 1.10 | 1.50 | Magnesium sulphate ($MgSO_4$) | 2.40 | ........ |
| Magnesium (Mg) | .30 | 1.10 | Magnesium chloride ($MgCl_2$) | 1.20 | 4.30 |
| Sodium (Na) | 1.20 | 6.11 | Potassium bicarbonate ($KHCO_3$) | 1.50 | ........ |
| Potassium (K) | .60 | 3.00 | Potassium chloride (KCl) | ........ | 5.70 |
| Sulphuric acid ($SO_4$) | .40 | 2.60 | Sodium chloride (NaCl) | ........ | 12.10 |
| Chlorine (Cl) | 2.40 | 14.00 | Sodium bicarbonate ($NaHCO_3$) | 4.50 | 4.00 |
| Bicarbonic acid ($HCO_3$) | 4.20 | 3.00 | Sodium nitrate ($NaNO_3$) | ........ | .70 |
| Nitrates ($NO_3$) | ........ | .50 | Total solids | 10.20 | 31.80 |
| Calcium sulphate ($CaSO_4$) | .60 | 3.60 | | | |
| Calcium chloride ($CaCl_2$) | ........ | 1.40 | | | |

The analysis of the water from English Bayou was made on a sample taken from the bayou while the pumps were at rest. The low solid content indicates that it is of excellent quality for use in irrigation. The solids in the water from the Indian Bayou are somewhat high in sodium chloride, or common salt, but no serious results need be feared from the use of this water for irrigation.

It is commonly believed that the water from the bayous of this section have valuable fertilizing properties. The results of the analyses do not show this belief to be founded on fact. As the current of the bayous is very sluggish, little sediment is carried in the water, and the rice fields get little benefit from this source of fertility.

The canals of the area are constructed by individuals, corporations, or companies. The companies generally have large plantations of their own, though a tenant system is also practiced. The water is contracted to these tenants by the year. The rent is commonly one-fifth of the crop, but sometimes the quantity is stipulated, when 2 sacks per acre is the usual charge.

No data are available regarding the amount of water necessary to irrigate an acre of rice. No system of supply has been established, and this part of the irrigation system is very unsatisfactory, as one tenant may use twice as much water as another and yet pay no more for the privilege. A more systematic management would greatly reduce the expense of operation and benefit everyone.

Deep wells are also used to furnish water for irrigation. These wells are sunk to a depth of from 150 to 250 feet, where a plentiful supply of water, which rises nearly to the surface of the ground, is reached. In constructing such an irrigation system a number of wells are sunk near each other—their diameter and number depending upon the supply required. These are connected at the surface with a common reservoir, from which the water is raised by an ordinary centrifugal pump and distributed by canals.

There are in the area a very few small plants now obtaining their water supply from wells, but data of interest with regard to their operation could not be obtained. The section of the country where wells are an important factor in irrigation lies in the neighborhood of the towns of Welsh and Jennings, which are outside of the present survey.

Occasionally, on certain rice lands where drainage is not adequate, salt residues are present in sufficient quantity to form crusts. These are produced largely by evaporation of irrigation water. In irrigated sections where, after harvest, a heavy covering of salts accumulates on the land in various places, some plan of relief should be introduced.

In the discussion of the origin of the sand mounds mention was made of the salt often found at the bases of the mounds. These salt crowns, where they occur in the rice fields, prevent germination of the seed.

The following analyses were made of samples taken from the bases of hummocks or from hummock surfaces. The analyses indicate rather conclusively that the cause of crop failure in such places is due to the harmful salts present in the soil. Indications also point toward the fact that the rice plant can not withstand much alkali.

*Chemical analyses of salts in soils.*

| Constituent. | 35. Sec. 18, T. 10 S., R. 7 W., 0 to 4 inches. | 36. Sec. 4, T. 10 S., R. 7 W., 0 to 2 inches.[a] | 56. Sec. 1, T. 10 S., R. 7 W., 0 to 4 inches.[a] | 103. Sec. 16, T. 9 S., R. 7 W., 0 to 4 inches.[b] | 106. Sec. 5, T. 9 S., R. 7 W., 0 to 3 inches. | 107. Sec. 30, T. 9 S., R. 7 W., 0 to 3 inches. |
|---|---|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Ions: | | | | | | |
| Calcium (Ca) | 2.34 | 1.55 | 5.40 | 7.61 | 1.43 | 2.72 |
| Magnesium (Mg) | .......... | 1.16 | 5.57 | 5.88 | 2.14 | 3.75 |
| Sodium (Na) | 24.56 | 28.30 | 16.72 | 20.06 | 27.97 | 23.59 |
| Potassium (K) | 3.51 | 2.71 | 1.64 | 1.73 | .99 | .......... |
| Sulphuric acid ($SO_4$) | 17.55 | 41.48 | 62.79 | 1.73 | 54.20 | 61.60 |
| Chlorine (Cl) | 5.85 | 15.90 | 5.74 | 60.55 | 11.84 | 4.87 |
| Bicarbonic acid ($HCO_3$) | 46.19 | 9.90 | 2.14 | 2.43 | 1.43 | 3.47 |
| Conventional combination: | | | | | | |
| Calcium sulphate ($CaSO_4$) | 8.19 | .......... | 18.36 | 2.42 | 4.85 | 9.17 |
| Magnesium sulphate ($MgSO_4$) | .......... | 5.42 | 27.54 | .......... | 10.55 | 18.45 |
| Sodium sulphate ($Na_2SO_4$) | 16.96 | 55.06 | 41.13 | .......... | 62.63 | 59.75 |
| Sodium chloride (NaCl) | 9.36 | 26.36 | 8.69 | 49.50 | 19.54 | 7.95 |
| Sodium bicarbonate ($NaHCO_3$) | 57.88 | .......... | .......... | 3.11 | .......... | 4.68 |
| Potassium bicarbonate ($KHCO_3$) | 7.61 | 6.96 | 3.29 | .......... | 2.43 | .......... |
| Calcium bicarbonate $Ca(HCO_3)_2$ | .......... | 6.20 | .......... | .......... | .......... | .......... |
| Potassium chloride (KCl) | .......... | .......... | .99 | 3.11 | .......... | .......... |
| Calcium chloride ($CaCl_2$) | .......... | .......... | .......... | 19.03 | .......... | .......... |
| Magnesium chloride ($MgCl_2$) | .......... | .......... | .......... | 22.83 | .......... | .......... |
| Total soluble salts | .34 | .57 | 1.22 | .54 | 1.40 | 2.13 |

[a] These samples were taken from surfaces where mounds had been leveled.
[b] No. 103 is an alkali soil taken from barren spot in a field, and shows harmful accumulation of salt due to evaporation of irrigation water.

The salts found in these soils are such as commonly exist in alkali land. In all cases carbonates or black alkali are absent.

Field observations thus far made indicate that the rice plant can not develop on land containing 0.30 per cent of salts in the surface foot.

Alkali accumulations upon the area surveyed will never, perhaps, become a serious menace to the farmer. In poorly drained districts, however, local trouble from salt is apt to appear unless care is taken to avoid the use of brackish flood water.

## UNDERGROUND AND SEEPAGE WATERS.

The undergound seepage water of the area does not play an important part in its agriculture.

There exists over the area, varying from 12 to 20 feet beneath the surface, a stratum of water-bearing sandy clay and sand. This stratum in the northern parts of the area lies at a depth of about 16 feet. It gradually comes nearer the surface as we go southward or toward the Gulf, until at the south line of the area surveyed its depth is about 13 feet.

The supply of water from wells sunk to this level is adequate for

farm animals and general household use, though the stratum sometimes rests upon shell beds and coast mud, which makes the water in wells located in such places undesirable. This supply comes from the rains on the surface of the ground. During the wet seasons of the year many wells fill with water often to within 2 feet of the surface. The normal position of the water is, however, about 12 feet below the surface. The temperature of the water from these wells is about 70°.

At a depth of from 150 to 270 feet below the surface another larger water-bearing stratum is encountered. This stratum is in river gravel and lies at the bottom of the Port Hudson group. In this stratum wells are sunk for irrigation water supply.

Underlying the area at a depth of from 450 to 600 feet is an artesian basin. The city supply at Lake Charles and the well at the sugar refinery southwest of Lake Charles are in this stratum. The temperature of this water as it comes to the surface ranges from 72½° F. to 74° F.

The following analysis of artesian water taken from the city well at Lake Charles indicates its composition:

*Analysis of artesian well water.*

| Ion. | Parts per 100,000. | Conventional combination. | Parts per 100,000. |
|---|---|---|---|
| Calcium (Ca) | 2.10 | Calcium sulphate ($CaSO_4$) | 1.40 |
| Magnesium (Mg) | .80 | Calcium chloride ($CaCl_2$) | 4.70 |
| Sodium (Na) | 5.40 | Magnesium chloride ($MgCl_2$) | 2.10 |
| Potassium (K) | 3.00 | Magnesium bicarbonate $Mg(HCO_3)_2$ | 3.00 |
| Sulphuric acid ($SO_4$) | 1.00 | Potassium bicarbonate ($KHCO_3$) | 5.70 |
| Chlorine (Cl) | 4.60 | Sodium bicarbonate ($NaHCO_3$) | 18.90 |
| Bicarbonic acid ($HCO_3$) | 18.90 | | |
| Total salts | 35.8 | | |

This water would prove satisfactory for irrigation purposes, and should it be possible to obtain a constant flow, it would seem that the supply might be developed for private irrigation systems.

In the field a study was made of the level of the underground water. This water table is subject to such great fluctuations that the map as constructed could apply to only one season of the year, and therefore it has not been published.

## AGRICULTURAL CONDITIONS.

The rice industry, while young, is already important and destined to greater importance in the near future.

The cultivation of rice upon a large scale is making it necessary to stock the country with work animals and cattle. They are indispensable to its success. As yet the locality produces no forage crop of value, and no grain with which to carry the work animals through the

seasons of labor. Stock food is purchased at high prices and shipped in from northern sections of the country, and the meat supply of the people also comes largely from northern markets. The rice area should produce its own stock food and enough beef and dairy products to supply its needs.

The increase in population of the surrounding territory is rapidly creating a demand for orchard and garden products. Until the present little attention has been paid to such production. The higher and lighter soils of the area are well adapted to such crops, and a few years should see this section producing much of the fruit consumed by its people. At present cabbage, celery, and certain other garden products are shipped in from California, but with the cheap labor and favorable soils and climate of the Lake Charles area these could easily be grown at home.

The railroad facilities of the locality are good. The area is crossed by the Southern Pacific Railway, and the New Orleans market can be reached over its line in a few hours. The city of Lake Charles is entered also by a branch line of the Port Arthur Route, and is thus directly connected with Kansas City and other Northern points. The Kansas City, Watkins and Gulf road has a terminal in the city which extends northward to connect with the Iron Mountain of Missouri and St. Louis. It is thought that with a comparatively small outlay the channel of the Calcasieu River could be made navigable for ocean-going vessels, thus adding greatly to shipping facilities.

The roads of the area are poorly constructed and in a poor state of repair, although with the local facilities good roads are practicable if proper care be taken in their construction.

The general conditions are those of a new and rapidly developing country, and it is not to be expected that all the changes necessary to the best interests of the people will be made at once. The future will doubtless see many of the improvements suggested in this report worked out by the people themselves.

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U.S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

# SOIL MAP

LOUISIANA
LAKE CHARLES SHEET


Soils Surveyed by
W. H. Heileman and
Louis Mesmer
1901

BASE MAP REDRAWN
FROM COUNTY MAP

Scale 1 inch = 1 mile

A. Hoen & Co. Lith. Baltimore, Md.

Field Operations
Bureau of Soils
1901